XLVI. *Obſervations of the Tranſit of* Venus *over the* Sun, June 3, 1769. *In a Letter to the Reverend* Nevil Maſkelyne, *F. R. S. Aſtronomer Royal, from* John Winthrop, *Eſquire, F. R. S.* Holliſian *Profeſſor of Mathematics at* Cambridge, *in* New England.

Cambridge, New-England, Sept. 5, 1769.

REVEREND SIR,

Read Dec. 7, 1769. I BEG leave to lay before you my obſervation of the late tranſit of Venus, the beginning of which I obſerved, in this place, with all the care I was capable of. Our ſituation on this North American coaſt, I am ſenſible, was not the moſt favourable, as we could ſee only the firſt part of the tranſit; yet, I preſume, careful obſervations, wherever made, will have their uſe in determining the grand problem of the Sun's parallax; at leaſt, may ſerve as collateral evidences to the capital obſervations.

Our apparatus having been wholly deſtroyed by fire, about five years ago, we have ſince procured a new ſet of aſtronomical inſtruments, made by ſome of the moſt eminent hands in London. A clock, by Mr.

Mr. Ellicott, with the pendulum of his invention, having the bob ſupported by levers. An aſtronomical quadrant, of 2 feet radius, made by Mr. Siſſon; and an equal altitude inſtrument, by Mr. Bird; each having three horizontal wires in the teleſcope. A reflecting teleſcope, of four feet focus; another of two; and another of 1 foot; fitted with an object glaſs micrometer, of 21½ feet focus; all three made by the late Mr. James Short.

I was obliged to remove the clock to another apartment, for the ſake of the tranſit, which I did on the 23d of May, when I took ſome equal altitudes. By reaſon of an almoſt continual ſucceſſion of cloudy weather till the end of that month, I could make but few material obſervations afterwards for regulating the clock. But, happily, the weather cleared up on the 1ſt of June, about noon, and continued fine for ſeveral days. As the preciſe knowlege of the true time is of the utmoſt conſequence in the preſent caſe, I ſuppoſe a particular account of the obſervations made for this purpoſe, within a few days of the tranſit, will be moſt ſatisfactory to you; and this muſt be my apology for the prolixity of the detail.

Obſer-

Observations for regulating the clock.

1769 June 24 1 Very cloudy till noon; the Sun hardly visible for a minute at a time; so that I could make only the following sparse observations.

Equal altitudes of the Sun's limbs.

	Morning.	I. Afternoon.	Middle Times
	h ′ ″	h ′ ″	h ′ ″
	7 55 13	4 0 6	11 57 39,5
			equation— 4,2
			11 57 35,3 ⊙ on the meridian
II.			
	8 13 36	41 43	—11 57 39,5
	14 6	3 41 13	equation— 3,9
			11 57 35,6 ⊙ on the meridian
III.			
	8 21 21	3 33 57	11 57 39
			equation— 3,8
			11 57 35,2 ⊙ on the meridian

⊙ on the meridian.

	h ′ ″
I.	11 57 35,3
II.	35,6
III.	35,2
Mean	11 57 35,4—

or, true time of noon by the clock.

♀ 2

I.

⊙'sup. limb	1	8 3 39	51 49	44
	2	4 49	50 38	43,5
	3	6 0	49 28	44
low. limb	1	6 30	48 58	11 57 44
	2	7 41	47 46	43,5
	3	8 52	3 46 35	43,5

Mean 11 57 43,75
Equation −3,77
⊙ on meridian 11 57 40

II.

⊙'sup. limb	1	8 11 47	43 41	44
	2	12 58	42 31	44,5
	3	14 9	41 19	11 57 44
low. limb	1	14 39	40 49	44
	2	15 50	39 38	44
	3	17 1	3 38 27	44

Mean 11 57 44,1
Equation −3,7
⊙ on meridian 11 57 40,4

1769 June ♀ 2

		Morning.	Afternoon.	Middle times.
		III.		
		h ′ ″	h ′ ″	h ′ ″
⊙'s up. limb	1	8 35 42	19 45	43,5
	2			
	3	36 54	18 33	43,5
low. limb	1	37 25	18 2	11 57 43,5
	2	38 37	16 51	44
	3	39 48	3 15 40	44
			Mean	11 57 43,7
			Equation	−3,3
			⊙ on meridian	11 57 40,4

		IV.		
⊙'s up. limb	1	8 41 49	13 37	43
	2	43 1	12 25	43
	3	44 13	11 14	11 57 43,5
low. limb	1	44 45	10 43	44
	2	45 57	9 30	43,5
	3	47 10	3 8 17	43,5
			Mean	11 57 43,4
			Equation	−3,2
			⊙ on meridian	11 57 40,2

⊙ on the meridian.

	h ′ ″
I.	11 57 40
II.	40,4
III.	40,4
IV.	40,2

Mean of all 11 57 40,3
or, true time of noon by the clock.

		I.		
♄ 3 ⊙'s up. limb	1	7 46 28	9 12	
	2		8 1	11 57 50
	3	47 39		equat. −3,8
low. limb	1	48 9	7 31	
	2	49 20	4 6 20	
	3			
			⊙ on meridian	11 57 46,2

		II.		
⊙'s up. limb	1	7 51 38	4 2	50
	2	52 48	2 51	49,5
	3	53 59	1 40	11 57 49,5
low. limb	1	54 29		
	2	55 40	4 0 0	50
	3	56 50		
			Mean	11 57 49,75
			Equation	−3,74
			⊙ on meridian	11 57 46

1769

1769 June ♄ 3

		Morning.	Afternoon.	Middle times.
		III.		
		h ′ ″	h ′ ″	h ′ ″
⊙'s sup. limb	1	7 58 51	56 46	48,5
	2	8 0 2	55 35	48,5
	3	1 13	54 34	11 57 48,5
low. limb	1		53 55	
	2	2 54	52 46	50
	3	4 5	3 51 35	50
		Mean		11 57 49,1
		Equation		−3,6
		⊙ on meridian		11 57 45,5

⊙ on the meridian.

I.	11 57 46,2
II.	46
III.	45,5
Mean of all	11 57 45,9

or, true time of noon by the clock.

At 4h 15′ thermometer 85¼.

⊙ 4

		I.		
⊙'s sup. limb	1	7 45 1	10 51	56
	2	46 12	9 40	56
	3	47 23	8 29	11 57 56
low. limb	1	47 53	7 59	56
	2	49 4	6 48	56
	3	50 14	4 5 37	55,5
		Mean		11 57 56−
		Equation		−3,6
		⊙ on meridian		11 57 52,4
		II.		
⊙'s sup. limb	1			
	2	7 52 32	3 20	56
	3	53 42	2 9	55,5
low. limb	1	54 12	1 40	11 57 56
	2	55 23	4 0 29	56
	3	56 34	3 59 18	56
		Mean		11 57 56−
		Equation		−3,5
		⊙ on meridian		11 57 52,5
		III.		
⊙'s sup. limb	1	7 57 38	58 11	54,5
	2	58 50	57 0	55
	3	8 0 2	55 49	11 57 55,5
low. limb	1	0 32	55 19	55,5
	2	1 42	54 8	55
	3	2 43	3 52 57	55
		Mean		11 57 55,1
		Equation		−3,4
		⊙ on meridian		11 57 51,7

⊙ on the meridian.

I.	11 57 52,4
II.	52,5
III.	51,7
Mean of all	11 57 52,2

or, true time of noon by the clock.

Obſervation of the TRANSIT of VENUS.

I choſe to obſerve the tranſit with the 2 feet teleſcope, as I ſuppoſed moſt of the obſervations in other parts would be made with teleſcopes of that ſize; and I uſed a power that magnified 90 times, which gave a very diſtinct view of the ſpots then on the Sun, Soon after two o'clock, I began to look on the Sun's upper limb, where the Planet was to enter. The firſt impreſſion I perceived was at $2^h\ 27'\ 51''$, by the clock, the Sun being then perfectly clear. I then reſted my eye, which was pretty much fatigued, to prepare it for the total ingreſs or interior contact. At $2^h\ 45'\ 15''$, I began to be doubtful whether the internal contact was not formed; but at $20''$ was ſatisfied that it was paſt, the Sun's limb being reſtored to its integrity, in the place where it had been interrupted by the Planet. During this interval of near $5''$, there ſeemed to be a duſkiſhneſs in the place of contact; my idea of which is well repreſented by Mr. Dunn's figure of what he calls the grey contact, in Phil. Tranſ. Vol. LII. Tab. VII. p. 190.

By the foregoing equal altitudes it appears, that the clock was now $2'\ 13''$ + too ſlow. I therefore ſtate the obſervation as follows:

	Apparent time. h ′ ″
Firſt viſible impreſſion of Venus upon the Sun	2 30 4
Internal contact	47 30

This time of internal contact, I think, cannot differ above $2''$ from the truth, and perhaps may not differ

differ 1″. But about 4″ of Venus's diameter muſt have entered upon the Sun before I perceived the impreſſion. At nine in the morning, I obſerved the Sun's diameter, in the horizontal direction, to be 1 21 1 parts of the micrometer, = 31′ 33″,2. At 5ʰ 34′ 23″, the Sun's north limb was diſtant from Venus's ſouth limb 9 3 of the micrometer, = 6′ 16″,2. At 5ʰ 37′ 23″, I found no ſenſible difference; and the Sun's north limb was then diſtant from Venus's north limb 7 14½ of the micrometer, = 5′ 17″,6. This gives Venus's diameter 58″,6; and the leaſt diſtance of centers 9′ 59″,7. Hence, the true duration of the ingreſs ſhould be 18′ 56″; but this being here contracted 15″, by parallax, is reduced to 18′ 41″. So that the firſt contact, ſtrictly ſo called, happened 1′¼ before the impreſſion was diſcovered; and the central ingreſs was at 2ʰ 38′ 5″. The neareſt approach was nearly, I ſuppoſe, at 5ʰ 37′.

After Venus was entered upon the Sun, I viewed her attentively ſeveral times, with a power of the great teleſcope which magnified 260 times, but could perceive no ſuch duſkiſhneſs round her as I ſaw at the internal contact, nor that imperfect light upon her diſk, eſpecially near the centre, which Mr. Dunn ſpeaks of; neither could I diſcover any ſatellite. Soon after ſix, the weſtern ſky began to be over-caſt, ſo that for a conſiderable time before ſun-ſet the Sun was hid.

I made obſervations for determining ſome other poſitions of Venus upon the Sun; but as they can be of no ſervice in the grand problem of the parallax, I think it needleſs to ſwell this letter, very long already, with them. I therefore only add, that the latitude of this

this place is nearly 42° 25′ N. and the difference of meridians weſt from London about 4^h 44′. But this may be farther aſcertained by the following emerſions of Jupiter's ſatellites, which I obſerved with the 2 feet reflector.

Emerſions of Jupiter's firſt ſatellite.

		Apparent time. h ′ ″			Apparent time. h ′ ″
1768	April 25	9 13 52	1769	May 14	10 19 7
	May 18	9 27 27		Aug. 23	7 31 50
	June 10	9 37 25			
	July 3	9 45 54			

Emerſion of 4's ſecond ſatellite.

June 7 9 1 15

I ſubmit the foregoing obſervations to your candid acceptance; and am, with great reſpect,

REVEREND SIR,

Your moſt obedient humble ſervant,

John Winthrop.

XLVII. *Of*